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SHORT COMMUNICATION

# First Locality Record of Melanistic Oncilla (*Leopardus tigrinus*) in Monteverde, Costa Rica

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## Abstract

The persistence of the coat color polymorphism melanism has been reported for several tropical felids, but its evolutionary advantages remain an active area of research. Few publications have explored melanism in the elusive species, oncilla (*Leopardus tigrinus*) within the Neotropical part of their range in Costa Rica. Herein, I present the first record of a melanistic oncilla within the montane cloud forest of Monteverde, Costa Rica. Recent studies have found support for theories (e.g. Temporal Segregation Hypothesis and Gloger's Rule) explaining the ecological advantages driving melanism in oncilla and tropical felid populations. However, it is unclear what is driving melanism in this Monteverde oncilla population due to the singular observation. Further research investigating whether melanism is occurring at a higher frequency in other individuals in the region is critical to better understanding the occurrence of melanism in local populations of this cryptic species. The montane cloud forest in Monteverde provides critical habitat to this vulnerable species within the small Neotropical part of their range. Melanistic individuals may be particularly threatened by land-use change and increasing human pressure if theories for the evolutionary advantages and ecological conditions motivating melanism are supported.

## Keywords

conservation, cryptic species, Felidae, melanism, natural history, oncilla, tropical ecology

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PENSOFT

The northern tiger cat or oncilla, as it will be hereafter described, (*Leopardus tigrinus*) ranges from southern Brazil and north-eastern Argentina to Costa Rica. Populations in Panama and Costa Rica are disjunct from those in South America (Sunquist and Sunquist 2002; Nascimento and Feijó 2017) which is reflected in the significant genetic divergence observed between the Costa Rican and Brazilian populations (Macdonald et al. 2010). Out of 41 species of felids across the globe (Kitchener et al. 2017), 14 species demonstrate a melanistic coat morph resulting in black coloration, that exists concurrently with a "wild-type" pattern consisting of rosettes, spots or a uniform color (Schneider et al. 2012; Silva 2017; Graipel et al. 2019; Mooring et al. 2020). Melanism is a common polymorphism in tropical felids, particularly within the genus *Leopardus* (Eizirik et al. 2003) though it has independently evolved at least eight times, strongly suggesting melanism can provide an evolutionary advantage to felids in wild populations and that it may be particularly advantageous under specific environmental conditions (Eizirik et al. 2003; Forsman et al. 2008; Schneider et al. 2012, 2015; Silva 2017). Though the genetic basis for melanism in felids has been well elucidated, the means by which melanism provides ecological advantages to these individuals has only recently been explored and remains an active area of research (Forsman et al. 2008; Graipel et al. 2014, 2019; Silva 2017; Mooring et al. 2020).

Of the six felids in Costa Rica, four species have displayed melanism: oncilla (*Leopardus tigrinus*), jaguarundi (*Herpailurus yagouaroundi*), jaguar (*Panthera onca*) and the most recently documented, margay (*Leopardus wiedii*) (González-Maya et al. 2018). The genetic underpinning for melanism in oncillas remains elusive and very few papers exploring melanism in oncillas have been published (see: Graipel et al. 2014) with only one other recent paper exploring this phenomenon for oncilla populations in Costa Rica specifically (Mooring et al. 2020).

Herein, I present a new record for melanism in oncilla in a novel locality in Costa Rica. The locality record is within the Monteverde Cloud Forest Biological Preserve (Reserva Biológica Bosque Nuboso Monteverde) (10°18.0317'N, 84°47.6267'W; 1530 m a.s.l.) within the Monteverde-Arenal Bioregion in the Tilarán mountain range of Puntarenas, north-western Costa Rica (Fig. 1). The Monteverde Cloud Forest Biological Preserve is the first private conservation area established in Costa Rica in 1972, managed by the NGO Centro Científico Tropical (Centro Científico Tropical (CCT) 2021). It constitutes one of the few larger private and state-owned reserves in the immediate Monteverde Region, amongst several smaller, privately-owned reserves and forest patches. Monteverde is one of the most biologically important parts of Costa Rica, composed of 11 climatically-distinct Holdridge life zones, separated into narrow elevational bands (Holdridge 1966) harbouring high levels of endemism and 2.5% of the world's biodiversity (Centro Científico Tropical (CCT) 2021). Despite the enactment through the National Biological Corridor Program of the Bellbird Biological Corridor encompassing the greater Monteverde Region to encourage efforts to increase forest cover and connectivity from private lands to protected areas (SINAC 2016), significant historic habitat fragmentation and continued degradation persist outside of the reserves. These reserves thereby

provide critical refugia to a diverse array of taxa of the montane cloud forest, including endemic and threatened species.

Records were obtained using one camera trap in the Monteverde Cloud Forest Biological Preserve as part of a larger network of fifty-five cameras throughout the greater Monteverde Region, to estimate the diversity and distribution of medium-large mammals in relation to extent forest cover (Fig. 1). Camera trap photographs were gathered using a passive infrared motion and temperature activated Bushnell Trophy Cam (Bushnell Corporation, Lenexa, KS, USA) that ran continuously for 77 days. The individual was recorded on 7 September 2019, at 20:52 h in a section of continuous, primary forest in the Monteverde Cloud Forest Biological Preserve. There were no definitive observations of wild-type oncilla at this locality, aside from one possible record that could not be confidently discerned from margay (*Leopardus wiedii*). The melanistic individual is very dark in color (Fig. 2A–D) and a spotted coat pattern is barely discernible (Fig. 2D).

A number of theories have arisen regarding the possible ecological advantages of melanism in felids, including increased camouflage, resistance to parasites, sexual selection and thermoregulation (Graipel et al. 2014, 2019; Silva et al. 2017; Mooring 2020) and recent studies have investigated these theories to elucidate understanding on the phenomenon. Grapeil et al. (2014) and Mooring et al. (2020) examined the Temporal Segregation Hypothesis (Forsman et al. 2008) for oncillas in Brazil and oncillas and jaguars in Costa Rica, respectively. This hypothesis asserts that melanistic individuals will be more active on brighter, moonlit nights than their wild-type counterparts as they have greater camouflage and, therefore, higher hunting success, exploiting a wider feeding niche. Both studies found that patterns for melanistic oncillas were significantly higher on nights with brighter moonlight than their spotted counterparts and all other felid species. Mooring et al. (2020) also found that melanistic jaguars and oncillas were more active during the day than spotted individuals. Both studies concluded that the increased camouflage of melanism provides advantages on brighter nights and/or during daylight hours (oncillas: Mooring et al. 2020) due to higher hunting success. For oncillas, this behaviour may also reduce competition with spotted oncillas and other felids, a phenomenon that has been noted elsewhere (Oliveira et al. 2010; Oliveira-Santos et al. 2012).

Mooring et al. (2020) also examined Gloger's Rule, which predicts that melanism in mammals is driven by climatic variables, such as precipitation and moisture. Melanism will thereby provide an evolutionary advantage to mammals in tropical forest environments in comparison to open habitats either through improved thermoregulation or camouflage, ensuring increased hunting success (Silva et al. 2016; Mooring et al. 2020). They found support for Gloger's Rule through observations of a higher average of individual records of melanistic jaguars (25%) and oncillas (32%) when observing only tropical forest habitats, compared to the global 10% average for jaguars (Silva 2017) and findings by Graipel et al. (2014) in Brazil for melanistic oncilla (18%) that included observations from both open and closed habitats. They conclude that melanism appears to provide an evolutionary advantage to individuals in closed, tropical forest habitats likely due to better camouflage

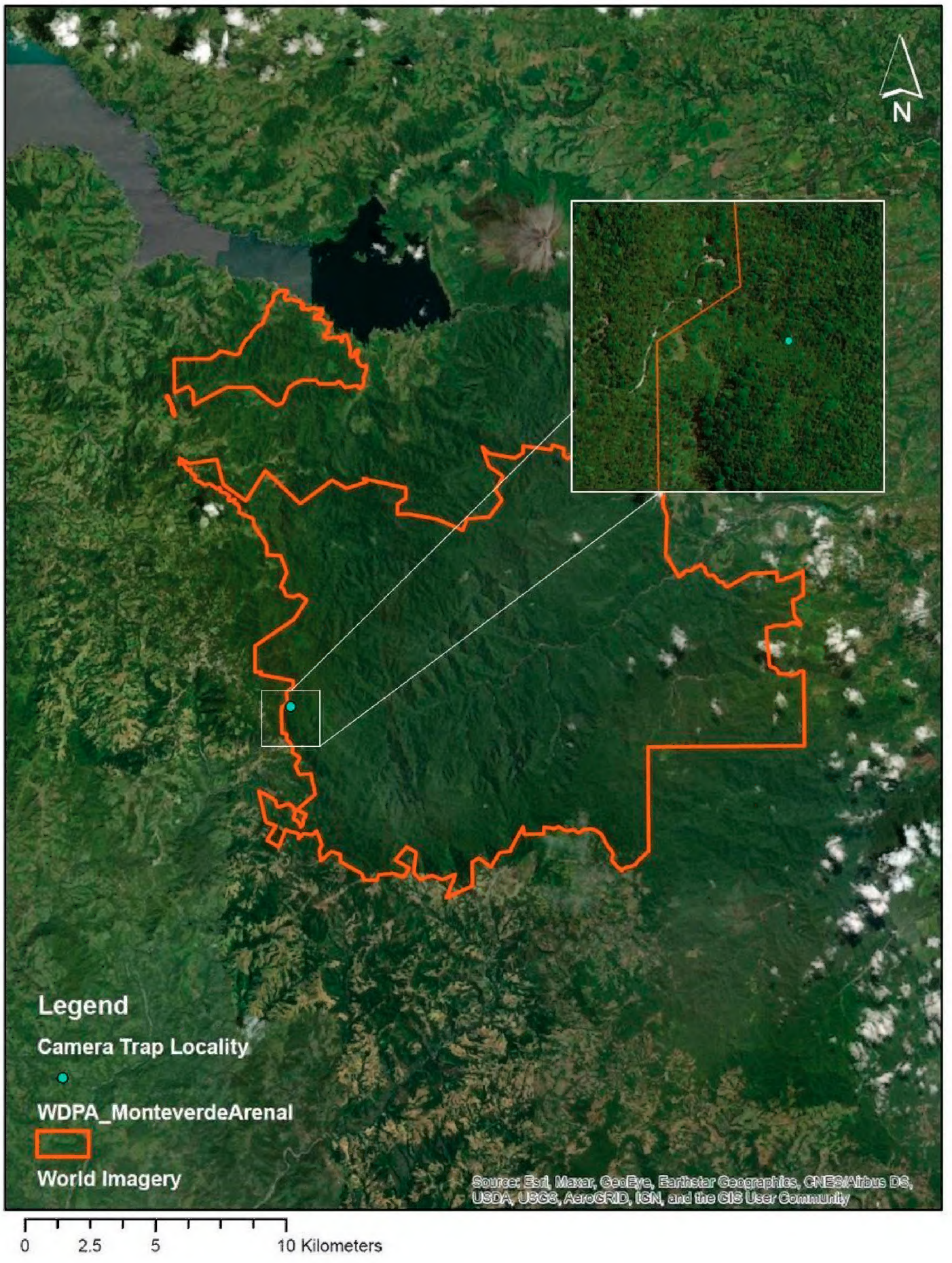


**Figure 1.** Map displaying the camera trap point locality where the melanistic oncilla individual was recorded within the Monteverde Cloud Forest Biological Preserve and greater Monteverde-Arenal Bioregion (outlined in orange), Costa Rica. Inset provides closer look at exact context of camera trap locality. Monteverde-Arenal protected area shapefile provided by: IUCN, UNEP-WCMC (2021).

or increased thermoregulation (Mooring et al. 2020). This is in support of previous findings by Silva (2017) investigating the relationship between environmental variables and melanistic jaguar distributions throughout their range that found that

**Figure 2.** First records of melanistic oncilla (*Leopardus tigrinus*) for Monteverde, Costa Rica.

melanism was not randomly distributed, was absent in open habitats and was related to climatic variables (humidity).

As oncillas in the Neotropics are primarily restricted to montane cloud forest (Macdonald et al. 2010), this new record of melanism supports the pattern of finding felid melanism in cloud forest environments, which may reinforce the hypothesis of an evolutionary advantage to oncillas in the dense cloud forest of the Monteverde Cloud Forest Biological Preserve in Costa Rica, as per Gloger's Hypothesis (Mooring et al. 2020). The observed presence of ocelot (*Leopardus pardalis*) and puma (*Puma concolor*) at this locality could also indicate that melanism is providing oncillas camouflage to reduce interspecific competition and increase hunting success through temporal segregation. The absence of sympatric wild-type oncilla observations at this locality may further suggest that ecological factors are driving the occurrence of melanism in this population. There was one record of a smaller spotted felid at this locality, but as there was only one, unclear photo, it was not possible to discern with confidence whether it was a wild-type oncilla or margay. The rarity of observations of melanistic oncillas in this region may, however, indicate that this is a random mutation rather than an adaptive advantage. While non-melanistic oncillas have been observed in recent mammal studies in the Monteverde Region (Zamzow et al. 2018), observations are notably rare and much less frequently recorded than its more common *Leopardus* relatives and puma (Personal communication;

JE Rogan unpublished data) and it is possible it was misidentified due to its strong resemblance to margay (Zamzow et al. 2018). Further research efforts to gauge the frequency of melanistic oncillas in the area will be key to better understanding this incredible phenomenon in this elusive species.

These findings of the first records of melanistic oncilla in Monteverde, Costa Rica are noteworthy as they contribute to knowledge on this rare species, described as "the most obscure of all Neotropical felids" (Giordano 2012) in a biologically-important area for oncilla persistence within the Neotropical portion of their range. The oncilla is currently listed as vulnerable with a declining population trend according to the IUCN Red List and is particularly threatened by habitat loss and agricultural development (Payan and de Oliveira 2016). Due to its complex taxonomy and the genetic separation between its Central and South American range, oncilla is currently undergoing taxonomic revision. If separated into southern and northern species, oncilla populations in Costa Rica would have an even smaller range and population size, greatly increasing its extinction risk (Nascimento and Feijó 2017). Melanistic individuals may be particularly vulnerable to the alteration of the ecological conditions that appear to drive this polymorphism. Dense forest habitat and climatic conditions are actively threatened by land-use change and climate change, both of which are impacting Monteverde ecosystems and various species (Pounds et al. 1999, 2006; Townsend and Masters 2015; Zamzow et al. 2018). In addition, felids are known to avoid humans (Tortato and de Oliveira 2005) and increased levels of human presence through high levels of ecotourism like that observed for Monteverde and its reserves, may further imperil their existence. This may particularly disrupt diurnal hunting practices of melanistic individuals, thereby reducing the adaptive advantage of melanism.

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